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The Development and Inter-Rater Reliability of the Department of Defense Human Factors Analysis and Classification System, Version 7.0

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14. ABSTRACT

This report describes improvements in the Department of Defense Human Factors Analysis and Classification System (DoD HFACS). Military services had a unanimous desire to improve DoD HFACS inter-rater reliability. A working group, composed of representatives from all services, met several times with the goal of improving inter-rater reliability while retaining the value of the tool. Additional requirements included preserving compatibility with existing databases and having inter-operability across the services. The steps involved included determining which "nanocodes" were rarely or never used and collapsing nanocodes and rewriting definitions to arrive at a total of 109 nanocodes, reduced from 147 nanocodes. A table, included in this report, allowing for the ready translation of old codes into new codes permits continued analysis of data already collected. The authors, in collaboration with the DoD HFACS Working Group, then developed a stepwise checklist to systematically guide investigators through consideration of nanocodes. Researchers tested several iterations of the technique using students in Air Force mishap investigation courses to gauge inter-rater reliability. Student investigators were also invited to offer constructive criticism to hone checklist questions. While inter-rater reliability results are encouraging, the DoD HFACS Working Group has additional work to accomplish to realize the goal of an optimally reliable human factors taxonomy. This report contains the complete DoD HFACS version 7.0 taxonomy as well as the checklist that was generated and tested with groups of mishap investigation students. Suggestions for future efforts are offered, to include an on-going research program.

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TABLE OF CONTENTS

LIST OF TABLES

Table **Page**

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1.0 SUMMARY

This report describes improvements in the Department of Defense Human Factors Analysis and Classification System (DoD HFACS). Military services had a unanimous desire to improve DoD HFACS inter-rater reliability. A working group, composed of representatives from all services, met several times with the goal of improving inter-rater reliability while retaining the value of the tool. Additional requirements included preserving compatibility with existing databases and having inter-operability across the services. The steps involved included determining which "nanocodes" were rarely or never used and collapsing nanocodes and rewriting definitions to arrive at a total of 109 nanocodes, reduced from 147 nanocodes. A table, included in this report, allowing for the ready translation of old codes into new codes permits continued analysis of data already collected. The authors, in collaboration with the DoD HFACS Working Group, then developed a stepwise checklist to systematically guide investigators through consideration of nanocodes. Researchers tested several iterations of the technique using students in Air Force mishap investigation courses to gauge inter-rater reliability. Student investigators were also invited to offer constructive criticism to hone checklist questions. While inter-rater reliability results are encouraging, the DoD HFACS Working Group has additional work to accomplish to realize the goal of an optimally reliable human factors taxonomy. This report contains the complete DoD HFACS version 7.0 taxonomy as well as the checklist that was generated and tested with groups of mishap investigation students. Suggestions for future efforts are offered, to include an on-going research program.

2.0 INTRODUCTION

As will be demonstrated, "human factors" are causal in a majority of military mishaps. This report also reports on a Department of Defense (DoD) effort to improve the system used to categorize causal and contributing human factors. Specifically, recent attempts to improve coding methods with the goal of achieving better inter-rater reliability and ultimately more actionable recommendations to improve safety will be described.

Hartmann, in a widely read and highly regarded article, asserted that reliability is a necessary but not a sufficient basis for validity. Hartmann went on to specify that there are two methods that can be employed to determine reliability: percentage agreement reliability and reliability coefficient. Hartmann advocated for the latter over the former, as percentage agreement may produce inflated estimates of reliability [1]. Another issue to bear in mind when considering reliability is that categories must be mutually exclusive and exhaustive (that is, contain no overlapping elements and be complete) to achieve the highest reliability. Overlapping elements may result in observers using different categories for the same observation and thus finding fewer distinctions between entities being compared.

The roots of the Human Factors Analysis and Classification System (HFACS) are described in "A Human Error Approach to Accident Investigation: The Taxonomy of Unsafe Operations" [2] and catalogued in a Federal Aviation Administration technical report [3] and a book, *A Human Error Approach to Aviation Accident Analysis* [4]. Their system is built upon the "Swiss cheese" model of Reason [5]. Reason recommended that a mishap investigation start with the *unsafe acts*, which represent active failure. The investigation does not stop there, however, as latent failures and conditions are examined next. Latent conditions may exist

undetected and unexpressed for years and include *preconditions*, *unsafe supervision*, and *organizational influences*.

According to Reason, unsafe acts include both errors and violations [5]. Errors may be skill-based or may be due to decisional or perceptual factors. Violations may be routine (such as cutting the same corners that many others cut) or exceptional. Preconditions for unsafe acts include environmental (physical or technological) factors, conditions of operators (adverse mental states or adverse physiological states or physical/mental limitations), or personnel factors (crew resource management or personal readiness). Reason argued that it is also essential to investigate at the supervisory and/or organizational level because such factors have direct impact on preconditions [5]. Addressing preconditions is likely to reveal opportunities to improve safety.

Unsafe supervision includes inadequate supervision, supervisors planning inappropriate operations, a supervisor failing to correct a known problem, and supervisory violations. Finally, there are organization influences, to include resource management, organizational climate, and organizational process. One way to conceptualize these categories is to consider them "bins" containing the smaller units.

Table 1 depicts the results of a query of the Air Force Safety Automated System (AFSAS) database, which is accessed via a secure website, for fiscal years (FY) 2010 through 2013 (1 October 2009 through 30 September 2013) to assess overall human factors involvement in aviation mishaps. Table 2 shows the results of the overall involvement of human factors in ground mishaps. These numbers empirically demonstrate that human factors are, in fact, a major concern for aviation and ground safety.

Table 1. Aviation Mishaps for FY 2010 – 2013

Class[a]	Total No. Aviation Mishaps	Aviation Mishaps with at Least 1 Human Factors Code	Percentage of Aviation Mishaps with at Least 1 Human Factors Code	Total No. Human Factors Codes
A	129	113	87.60	1,452
B	218	113	51.83	754
C	2,518	895	35.54	2,586
D	3,142	737	23.46	1,179
E	28,803	1,094	3.8	3,185
Grand Total	34,810	2,952	59.59	9,156

[a]As defined in Air Force Instruction (AFI) 91-204 [6]. See Glossary.

It should be noted that DoD HFACS is not required to be used for Classes C, D, and E mishaps (highlighted). The reader is thus cautioned not to be misled by the lower percentages and the deflating impact on the grand total. The involvement of human factors is therefore likely heavily underestimated in U.S. Air Force (USAF) mishaps, particularly Classes C, D, and E mishaps, as a result.

Table 2. Ground Mishaps for FY 2010 – 2013

Class[a]	Total No. Ground Mishaps	Ground Mishaps with at Least 1 Human Factors Code	Percentage of Ground Mishaps with at Least 1 Human Factors Code	Total No. Human Factors Codes
A	216	207	95.83	1,038
B	100	81	81.00	311
C	13,985	5,901	42.20	10,385
D	19,685	4,069	20.67	5,556
E	859	94	10.94	292
Grand Total	34,845	10,352	38.73	17,582

[a]As defined in AFI 91-204 [6]. See Glossary.

Beaubien and Baker, while generally favorable in their review of HFACS, note that HFACS is a bit coarse as it does not delineate *reasons* for the conditions it identifies. Beaubien and Baker also note that latent failures are difficult to identify in mishap analysis [7]. The context of their review must be appreciated, as they were examining coding schemes that were used with data already collected. Their final point is important: HFACS categories are nominal and not sequential and thus do not reveal a chain of events. Therefore, they do not differentiate causes from effects. That issue, however, is relatively easy to remedy in the overall scheme of an investigation. For example, the USAF constructs a mishap sequence of contributory and causal findings and embeds DoD HFACS within it. O'Connor noted the above criticisms and detailed the efforts to address them, to include the formation of a DoD Working Group in 2003, which created DoD HFACS [8]. DoD HFACS introduced increased granularity, an additional level of classification: "nanocodes." The original DoD HFACS included 147 nanocodes, organized under the categories (bins) delineated above (*unsafe acts, preconditions, unsafe supervision, organization influences*). O'Connor examined the reliability of DoD HFACS, version 6.2. He found that U.S. Navy and Marine Corps aviators undergoing mishap investigator training were unable to achieve acceptable reliability, but noted that they had received only minimal training [8]. Although the raters were able to agree on the nanocodes *not* used, they were unable to achieve consistent agreement concerning which nanocodes applied ("there were only seven nanocodes in which 50% or greater of the participants agreed to select the nanocode," *p.* 602 [8]). O'Connor noted that raters were confused by the number (147) of available nanocodes and that the nanocodes contained overlapping concepts. He found that collapsing codes improved inter-rater reliability and therefore argued for nanocodes that are exhaustive, parsimonious, and mutually exclusive. O'Connor also noted that his research participants may not have been reading and considering the nanocodes' one-paragraph definitions, relying instead on the names of the nanocodes [8].

O'Connor called for subject matter experts to review the nanocodes to determine if some could be removed or combined with other nanocodes. He went as far as to suggest that the nanocode level be abandoned if acceptable reliability could not be achieved without extensive training [8]. A 2011 Aerospace Medical Association presentation, "DoD HFACS X: Inter-Rater Reliability," prepared by human factors practitioners (Brian T. Musselman, Jeffrey D. Alton, Thomas G. Hughes, Patricia LeDuc, Richard J. Farley, and Antonio B. Carvalhais) from the

three service safety centers, had four expert raters code 54 USAF Class A mishaps with DoD HFACS 6.2 [9]. They found a kappa coefficient of .5494 with 76 out of 147 (52%) nanocodes having reliability greater than or equal to .60. The authors recommended "improved code definition" and development of an "organized training curriculum" [9]. Subsequent studies used DoD HFACS X, which contained fewer nanocodes (102, rather than 147). The average kappa coefficient increased to an impressive 0.84 with expert coders, but novice coders continued to struggle, achieving kappa coefficients of .2453 and .3239. The authors urged the development of a decision tree algorithm, redesign of DoD HFACS into larger buckets (even if granularity would be sacrificed), and limiting coding at the nanocode level to experts only.

The steps in the current effort to improve DoD HFACS included determining the frequency that each of the nanocodes was used and considering retiring those nanocodes that were very infrequently used. Nanocodes that were similar in the phenomena they described, as evidenced by having overlapping definitions, were merged and the definitions reworked. The goal was to reduce the number of nanocodes and to improve the mutual exclusivity of the remaining nanocodes. Specifically, AFSAS was further queried for FY 2010 through 2013 for aviation and ground mishaps to determine the frequency of use of each of version 6.2's 147 nanocodes. The frequency of each HFACS nanocode for USAF aviation and ground mishaps is depicted in Appendix A. It should be noted that AFSAS was queried to arrive at two totals. The first count tallied a specific HFACS nanocode cited once per mishap (labeled "unique" in the tables). Otherwise, a given nanocode assigned against multiple members of a crew would inflate the total. The other tally counted the grand total of HFACS nanocodes used, with no restriction on how many times a nanocode was used in any given mishap. The U.S. Army and Navy, as members of the DoD HFACS Working Group, performed similar tallies. In the USAF, for example, PC 201 was used only once for all classes of aviation and ground mishaps. Finally, the DoD HFACS Working Group ensured that nanocodes were aligned in the correct bins. Nanocodes that were relocated to other bins were reassigned an alphanumeric to be consistent with the new bin. Ultimately, the 147 nanocodes in version 6.2 were collapsed to109 nanocodes in version 7.0. Table 3 provides the list of collapsed (version 7.0) nanocodes. The working group then developed a checklist, colloquially known as "Turbo HFACS," that uses a decision tree to guide investigators (see Appendix B). A response of "yes" guides the investigator to the correct "bin" and suggests a list of defined nanocodes.

This report delineates the motivation to change DoD HFACS 6.2 and to document the changes made in DoD HFACS 7.0. This report also examines the inter-rater reliability of DoD HFACS.

Table 3. Conversion Chart for DoD HFACS 6.2 Nanocodes Realigned into New Bins and Collapsed in DoD HFACS 7.0

Collapsed DoD HFACS 6.2 Nanocodes	Realigned DoD HFACS 6.2 Nanocodes	New DoD HFACS 7.0 Nanocodes
AE106		AE103
AE204	AE203	AE107
AE301		PC504
OC002		OC001
OR002		OR001
	OR004	OP007
	OR006	OS001
	OR007	OS002
PC201		PC202
PC210		PC209
PC211		PC207
PC212		PC209
PC213		PC209
PC214		AE206
PC301		PC304
PC303		PC305
PC306		PC305
PC308		PC307
PC309		PC305
PC313		PC312
	PC403	PC317
PC316	PP201	PC318
	PP204	PC319
PC401	PC405	PC109
PC402	PC405	PC109
	PC506	PC110
	PC403	PC317
PC404	PP201	PC318
	PC506	PC110
PC509		PC508
PC510		PC508
PE102		PE101
PE104		PE101
PE105		PE101
PE107		PE106
PE111		PE101
PP102		PP108
PP110		PP109
PP111		AE201
PP112		PP108
PP202		PC302
PP203		PC302
	PP204	PC319
PP205		PC307
PP206		PC305
SF002	SF001	SI007
SP004		SP003
	SP005	SI008

3.0 METHODS

3.1 Participants

Three hundred forty students attending USAF aircraft mishap investigation courses served as participants. Most of the participants were pilots and maintenance personnel attending the Aircraft Mishap Investigation Course (AMIC) at Headquarters, Air Force Safety Center, Kirtland Air Force Base, NM. Additional data were collected from aerospace medical personnel (flight surgeons, aerospace physiologists, and clinical psychologists) who attended the Aircraft Mishap Investigation and Prevention course, held at the USAF School of Aerospace Medicine, Wright-Patterson Air Force Base, OH.

3.2 Procedures

Participants were given approximately 45 minutes to read and code sanitized (basic identifying information had been removed) synopses of mishap reports that had been investigated by Safety Investigation Boards (SIBs). The synopses were approximately two typed, single-spaced pages in length, using a 10-point font. To protect privilege, all mishap reports were immediately collected at the conclusion of the exercises. These mishap synopses are not published here because the degree of additional sanitizing that would have been necessary to publish them in this report would have rendered them virtually incomprehensible.

The research design for this project was not strictly pre-planned, but rather it evolved and capitalized on opportunities that presented themselves. Above all, it was a proof of concept. Table 4 summarizes the evolution of the research activities. A more detailed account follows.

Table 4. Summary of the Evolution of DoD HFACS 7.0 Research Activities

First Trials	Second Trials	Third Trials
Student investigator teams provided Checklist only	Student investigator teams given answer sheets along with checklist and required to submit responses on it	Student investigator teams given answer sheets along with checklist and required to submit responses on it
Student investigator teams directed to use only DoD HFACS 7.0 for exercise	Student investigator teams directed to use DoD HFACS 6.2 and then introduced to version 7.0 for exercise	Student investigator teams taught to use DoD HFACS 6.2 and then introduced to version 7.0 for exercise
18-question version of checklist used	8-question (with subquestions) version of checklist used	8-question (with subquestions) version of checklist used
	Student investigator teams asked to list the three to five (and then the five) most important HFACS nanocodes	Student investigator teams asked to list the five most important HFACS nanocodes

3.2.1 First Trials. In the first data collections, 31 student investigator teams used an 18-question version of the DoD HFACS 7.0 checklist to code three aircraft mishap scenarios. The lead researcher (first author) presented a brief introduction (approximately 10 minutes) to the DoD HFACS 7.0 checklist. The participants were directed to use the questions of the checklist and work together in teams of two or three members. Following the advice of O'Connor and Walker [10], participants were organized into small teams rather than working alone to better simulate the conditions of an SIB. Participants were instructed to not speak to any member of *another* team about the mishap during the exercise.

3.2.2 Second Trials. The next series of data collection aimed to directly compare DoD HFACS 6.2 to DoD HFACS 7.0. Student investigator teams were given a mishap scenario and directed to first use version 6.2 as outlined in AFI 91-204 [6]. Table 5 presents the outcome as determined by the actual SIB and reviewed by the Memorandum of Final Evaluation (MOFE). After the student rater teams' responses were collected, the teams were trained to use version 7.0 (using basically the same introduction described above) and directed to again code the scenario, without regard to what they coded using version 6.2. To encourage student investigator teams to read nanocode definitions, they were required to record their answers on sheets that only contained the alphanumeric codes, so that they would not base their decisions merely on the names of the nanocodes without reading and considering the full definition. Moreover, rater groups were asked to list the three to five nanocodes that were the most important in the mishap, of course starting with those that they deemed causal. Following the input from the epidemiologists identified in the Acknowledgments, the participants were ultimately directed to list the five most important DoD HFACS nanocodes. In any case, the reader will note, as depicted in Table 5, that the actual SIB and the respective MOFE found 12 DoD HFACS nanocodes to be applicable.

Table 5. Results Determined by Actual SIB and MOFE for Mishap 1

Mishap-Level Nanocodes	Person-Level Nanocodes
OP004 (Contributory)	AE105 (Causal)
SI003 (Contributory)	PC102 (Contributory)
SP003 (Contributory)	PC307 (Contributory)
SP006 (Causal)	PC308 (Contributory)
	PC504 (Causal)
	PC508 (Causal)
	PE102 (Contributory)
	PP109 (Causal)

3.2.3 Third Trials. Another data collection was held using a mishap that had been coded with fewer nanocodes by the SIB and that included only nanocodes that transitioned to version 7.0. Because the purpose of AMIC is to train investigators and not serve as a research laboratory, this AMIC class received more detailed instruction on a strategy to use DoD HFACS 6.2. The student investigators needed to be prepared to investigate mishaps immediately upon the completion of their training and there was no start date yet established for the operational transition to version 7.0. In applying version 6.2, student investigators were urged to read and consider definitions rather than just rely on the one-page wire diagram. The following person-

level nanocodes resulted from the efforts of the actual SIB and MOFE (no mishap-level nanocodes were determined):

- AE202 (causal)
- AE201 (causal)
- PC206 (causal)
- PC102 (causal)
- AE105 (contributory)

After these student investigator teams completed their coding with version 6.2, their answer sheets were collected. These student investigator teams were then introduced to version 7.0, using basically the same instruction used in the first two trials.

3.2.4 Qualitative Feedback. The feedback received from students led the authors and the rest of the working group to continually refine questions, eventually arriving at a solution of eight questions with subquestions, located in Appendix C. Students were subsequently asked to provide written feedback on their opinions of the changes made in HFACS 7.0.

4.0 RESULTS

4.1 First Trials

During the first series of data collection, 18 of 31 (58%) rater teams selected the identical "yes" pattern when coding Scenario One using DoD HFACS 7.0. Four of the 31 (13%) rater teams selected an identical but alternate pattern. Twenty-four (77%) rater teams selected the same nanocodes (AE105, AE202, and PC102) as the top three (out of 109) overall codes. Fleiss' kappa in considering the responses to the 18 questions was .847. Fleiss' kappa for the 109 nanocodes was .545 and the average pairwise Cohen's kappa was .543.

The 18-queston version of DoD HFACS 7.0 did not fare as well with two other scenarios. In 25 rater teams coding Scenario Two, only four rater teams selected an identical "yes" pattern. There were two other common patterns, with each selected by two rater teams. Twenty (80%) rater teams selected the same top three codes, AE103, SV004, and SI001. Fleiss' kappa in considering the responses to the 18 questions was .498. Fleiss' kappa for the 109 nanocodes was .415 and the average pairwise Cohen's kappa was .400.

Scenario Three had 2 of 15 rater teams selecting an identical "yes" pattern. Five codes were selected 10 or more times by rater teams. Fifteen rater teams selected the top three overall codes: AV003, PC202, and PC204. Fleiss' kappa in considering the responses to the 18 questions was .550. Fleiss' kappa for the 109 nanocodes was .487 and the average pairwise Cohen's kappa was .512.

4.2 Second Trials

As seen in Table 6, during the exercise using Mishap 1, when the student rater teams used DoD HFACS 6.2, 9 out of 14 rater teams (64%) matched at least one of the above findings as being among their most important three to five DoD HFACS nanocodes. One rater team of 14 (7%) matched three nanocodes; 8 rater teams (57%) had one match, and 5 rater teams (36%) had

no matches of their top three to five DoD HFACS nanocodes to those of the SIB. Using DoD HFACS 7.0, two student rater teams (14%) had three matches; three student rater teams (21%) had two matches, nine student rater teams (64%) had one match, and zero student rater teams had no matches. Making this contrast even more stark (and more favorable to version 7.0) is the fact that two of the nanocodes identified in Mishap 1 using DoD HFACS 6.2, PC308 and PE102, did not transition to version 7.0 and thus were not available to the raters during the version 7.0 portion of the exercise.

Table 6. Comparing DoD HFACS 6.2 to 7.0 Anchored Against Actual SIB Results, Mishap 1

No. of Matches to Actual SIB	DoD HFACS 6.2	DoD HFACS 7.0
3	1 student rater team matched SIB	2 student rater teams matched SIB
2		3 student rater teams matched SIB
1	8 student rater teams matched SIB	9 student rater teams matched SIB
0	5 student rater teams	

4.3 Third Trials

Table 7 presents the results of the exercise using Mishap 2. Two rater teams elected to list only four codes as the "most significant" during the version 7.0 portion of the exercise and could not be persuaded to list more. By doing so, they lessened the opportunity to maximize matching what the SIB found.

Table 7. Comparing DoD HFACS 6.2 to 7.0 Anchored Against Actual SIB Results, Mishap 2

No. of Student Rater Team Matches to Actual SIB	DoD HFACS 6.2	DoD HFACS 7.0
4	3 student rater teams matched SIB	1 student rater team matched SIB
3	7 student rater teams matched SIB	5 student rater teams matched SIB
2	4 student rater teams matched SIB	5 student rater teams matched SIB
1		2 student rater teams matched SIB
0	1 student rater team matched SIB	

Finally, student raters were asked to provide written feedback on their perception of the relative value of version 7.0 over version 6.2. The tables in Appendix C depict, respectively, student rater team comments at the conclusion of the exercises using Mishaps 1 and 2 as well as a rejoinder, which, unfortunately, was not offered to the students at the time of their class attendance. The first set of comments is mostly neutral, as they are criticisms of both versions. The clearly positive comments, however, do outnumber the clearly negative comments by five to two. The second set of comments is more positive (9 out of 14, with no negative comments). Previously, comments from students were collected in a more informal fashion, but were still useful in the evolution of the checklist. Some typical themes from the student investigators

included that the new version is “less intimidating” and “less subjective” and gives investigations structure. Suggestions for improvement included the observation that some of the questions are too broad and the subquestions need to be read and considered even if the instructions advise users to skip over the subquestions.

5.0 DISCUSSION

In a series of comparisons using a variety of mishap scenarios, the checklist for DoD HFACS 7.0 performed well. These encouraging results can be explained as follows: A taxonomy that has fewer nanocodes and nanocodes that have distinct meaning improves user satisfaction and may, itself, increase inter-rater reliability. While a systematic approach to considering the larger categories as well as the nanocodes likely is a key component to the improvement of inter-rater reliability, simply encouraging student investigators to consult the definitions of the nanocodes also likely improved inter-rater reliability. Systematically guiding investigators to consider all nanocodes will increase the likelihood that the definitions of the nanocodes will be read and considered. As pointed out by previous researchers as noted in this report, requiring coding at a finer degree of granularity requires training and providing investigators with the proper resources, such as a checklist.

As noted in the comments of our participants, another issue is the correct structure of the checklist questions. Too many questions are likely to try the patience of investigators, while fewer questions with subquestions run the risk of investigators missing significant areas that could benefit from further inquiry. The feedback gleaned from the students who graciously participated in this research suggests that investigators would be wise to not skim over subquestions after answering “no” to the major question. While the DoD HFACS Working Group should consider honing the questions and subquestions, DoD HFACS 7.0 is a step in the right direction according to student feedback and the results obtained in this study. A future revision should revise the questions and elevate some of the subquestions to free standing questions. Above all, any strategy that gets investigators to read and consider the definitions of the nanocodes will result in a better investigative outcome. The “yes/no” format of the questions in version 7.0 results in a clear binning (getting in the ballpark of applicable nanocodes). Such binning of causes and contributing factors represents an advancement in investigations with actionable results, as it allows leaders to more accurately allocate resources to reduce future mishaps. Even if there is some disagreement as to which exact nanocode within a bin is the cause, at least the correct bin is identified and proper attention is paid to mitigation of a major cause or contributing factor of mishaps.

Future efforts should include a continued refinement of the questions, as noted above, as well as the creation of a small set of questions to assist Aviation Safety Action Program (ASAP) reporters submit reports that more clearly highlight human factors issues. ASAP reports are considered “safety without the mishap”; thus, better use of DoD HFACS could actually help improve safety. Above all, investigators in training in all services must be given ample opportunity to practice investigating and coding mishaps during the “organized training curriculum” advocated by Musselman et al. [9], using the guided approach provided by the checklist contained in Appendix B.

Coda: The Joint Service Safety Council approved DoD HFACS 7.0 in May 2014. The results of the inter-rater reliability studies were shared with the council, along with the unanimous recommendation from the human factors practitioners from all three safety centers

that it be formally adopted and operationally fielded. The Joint Service Safety Council seemed to be particularly encouraged that no previously collected and archived data will be lost as we transition to DoD HFACS 7.0. As noted, the conversion table (Table 3) included in this report will allow backwards translation of previously coded information.

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APPENDIX A

Frequency of HFACS Nanocodes for Aviation and Ground Mishaps

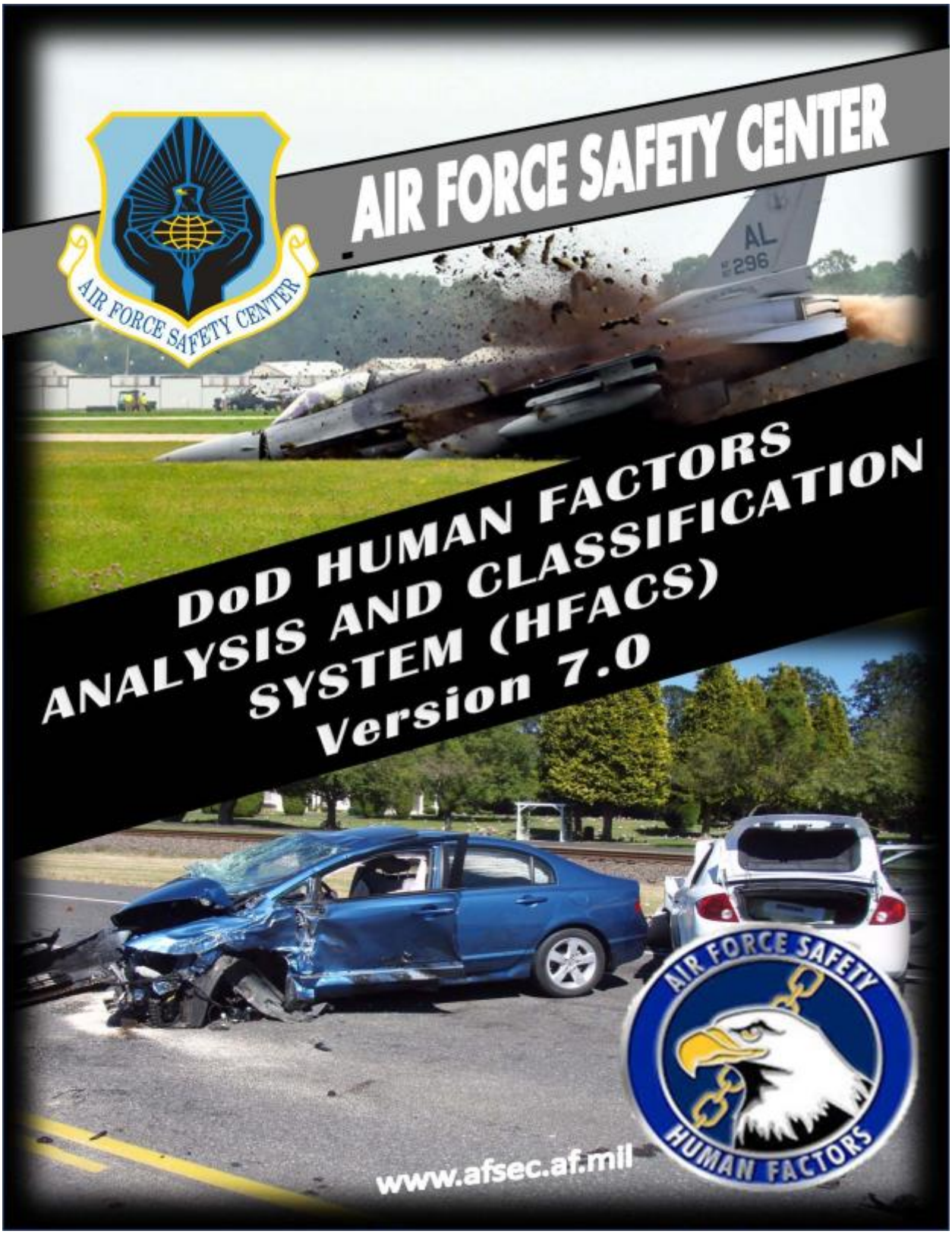
Nanocode	Class A Aviation *Causal*	Class A Unique Aviation *Causal*	Class A Aviation *Contributory*	Class A Unique Aviation *Contributory*	Class A Ground *Causal*	Class A Unique Ground *Causal*	Class A Ground *Contributory*	Class A Unique Ground *Contributory*	*All* Classes, Aviation & Ground	*All* Classes, Unique Aviation & Ground
AE101	4	4	3	3	3	3	2	2	133	129
AE102	29	19	10	7	-	-	-	-	302	205
AE103	39	29	15	12	11	11	8	7	597	536
AE104	9	9	9	9	22	22	19	18	505	486
AE105	16	9	22	13	4	4	4	4	228	189
AE106	1	1	-	-	-	-	-	-	33	32
AE201	24	12	27	18	51	41	69	53	2319	2135
AE202	11	10	19	13	-	-	1	1	173	148
AE203	1	1	3	3	2	2	9	8	695	670
AE204	4	4	11	6	-	-	-	-	131	108
AE205	3	1	3	3	12	12	20	13	463	425
AE206	17	11	22	15	23	22	-	-	1174	1098
AE301	19	11	19	11	15	9	20	19	1064	969
AV001	2	2	1	1	4	4	3	3	147	129
AV002	7	4	-	-	2	1	7	4	110	80
AV003	4	2	1	1	44	39	31	26	523	463
PC101	9	5	11	6	15	14	22	19	3417	3288
PC102	31	22	32	20	6	6	14	11	1248	1153
PC103	17	11	16	12	-	-	2	2	110	93
PC104	5	5	20	13	3	3	3	3	125	104
PC105	2	2	9	8	3	2	3	3	103	92
PC106	6	5	20	14	12	12	16	16	552	520
PC107	-	-	1	1	1	1	1	1	19	18
PC108	3	2	5	4	-	-	-	-	30	24
PC201	-	-	-	-	-	-	-	-	-	-
PC202	-	-	-	-	-	-	1	1	3	3
PC203	-	-	-	-	-	-	-	-	1	1
PC204	-	-	3	1	4	3	11	11	81	77
PC205	-	-	1	1	2	2	12	8	39	35
PC206	21	11	19	13	17	17	41	35	960	903
PC207	-	-	2	1	1	1	6	6	126	121
PC208	25	9	37	22	10	8	26	22	1234	1090
PC209	-	-	-	-	-	-	-	-	8	8
PC210	-	-	1	1	-	-	1	1	20	18
PC211	-	-	2	2	8	8	9	8	567	554
PC212	11	4	4	2	-	-	8	8	188	166
PC213	-	-	-	-	2	2	10	10	181	170
PC214	4	3	12	6	-	-	3	3	104	92
PC215	-	-	4	2	-	-	-	-	16	14
PC301	-	-	1	1	-	-	-	-	29	28
PC302	-	-	-	-	-	-	-	-	11	11
PC303	-	-	-	-	-	-	-	-	33	26
PC304	-	-	-	-	3	3	3	3	37	37
PC305	-	-	-	-	4	4	2	2	170	170
PC306	-	-	1	1	4	4	5	5	1033	1024
PC307	9	4	11	9	8	8	18	15	224	193
PC308	-	-	1	5	-	-	4	4	61	50
PC309	-	-	-	-	-	-	-	-	8	8
PC310	-	-	-	-	-	-	-	-	62	62
PC311	-	-	-	-	-	-	-	-	20	20
PC312	-	-	-	-	2	2	1	1	83	71
PC313	-	-	-	-	-	-	-	-	6	6
PC314	-	-	2	2	-	-	-	-	6	6
PC315	-	-	1	1	-	-	3	3	132	127
PC316	1	1	-	-	-	-	-	-	30	29

Nanocode	Class A Aviation *Causal*	Class A Unique Aviation *Causal*	Class A Aviation *Contributory*	Class A Unique Aviation *Contributory*	Class A Ground *Causal*	Class A Unique Ground *Causal*	Class A Ground *Contributory*	Class A Unique Ground *Contributory*	*All* Classes, Aviation & Ground	*All* Classes, Unique Aviation & Ground
PC401	-	-	-	-	-	-	-	-	10	10
PC402	-	-	4	3	-	-	-	-	20	17
PC403	-	-	-	-	-	-	-	-	108	108
PC404	-	-	-	-	1	1	6	6	105	105
PC405	1	1	16	9	-	-	-	-	175	145
PC501	-	-	-	-	-	-	-	-	10	9
PC502	-	-	7	5	-	-	-	-	9	8
PC503	2	2	9	6	1	1	2	2	66	57
PC504	8	6	13	9	12	12	10	8	330	299
PC505	8	5	7	5	-	-	-	-	41	29
PC506	4	3	20	11	2	2	10	9	277	238
PC507	-	-	1	1	-	-	-	-	8	8
PC508	10	7	4	3	-	-	-	-	28	23
PC509	3	3	4	4	-	-	-	-	20	19
PC510	-	-	1	1	-	-	-	-	3	3
PC511	4	2	12	9	-	-	-	-	20	15
PE101	-	-	3	2	-	-	-	-	25	24
PE102	4	2	29	16	1	1	20	19	285	246
PE103	-	-	-	-	-	-	-	-	6	6
PE104	-	-	-	-	-	-	-	-	36	23
PE105	-	-	-	-	1	1	1	1	45	41
PE106	-	-	-	-	1	1	1	1	56	56
PE107	-	-	-	-	-	-	-	-	85	75
PE108	-	-	2	2	-	-	-	-	22	17
PE109	-	-	-	-	-		-	-	15	8
PE110	1	1	-	-	1	1	-	-	32	23
PE111	-	-	4	1	-	1	-	-	29	16
PE201	6	1	6	3	2	2	-	-	25	16
PE202	-	-	32	19	-	-	-	-	71	45
PE203	-	-	12	8	1	1	5	4	131	117
PE204	1	1	4	3	2	1	-	-	58	50
PE205	3	3	9	6	-	-	-	-	24	19
PE206	-	-	-	-	-	-	-	-	32	32
PE207	-	-	-	-	-	-	6	6	60	56
PE208	-	-	-	-	-	-	-	-	32	20
PP101	2	1	9	5	-	-	1	1	95	74
PP102	12	5	37	18	1	1	3	3	268	163
PP103	2	2	4	3	-	-	3	3	36	35
PP104	1	1	3	2	-	-	1	1	28	20
PP105	2	2	10	5	-	-	3	3	63	48
PP106	11	7	11	7	3	3	2	2	189	150
PP107	4	1	3	1	-	-	-	-	41	29
PP108	-	-	-	-	1	1	-	-	56	44
PP109	3	1	2	1	1	1	4	3	82	66
PP110	-	-	9	7	-	-	6	3	51	37
PP111	11	3	8	4	-	-	5	1	78	49
PP112	1	1	4	2	-	-	1	1	212	168
PP201	-	-	-	-	-	-	1	1	159	158
PP202	-	-	-	-	40	40	34	24	265	236
PP203	-	-	-	-	-	-	2	2	9	9
PP204	-	-	3	2	-	-	1	1	43	42
PP205	2	1	2	2	3	3	12	12	120	113
PP206	-	-	-	-	-	-	-	-	8	8
OC001	1	1	1	1	1	1	4	4	88	88
OC002	-	-	-	-	-	-	1	1	4	4
OC003	4	4	4	4	1	1	8	8	189	189
OC004	-	-	-	-	-	-	-	-	15	14
OC005	-	-	-	-	-	-	-	-	17	17
OP001	-	-	-	-	-	-	1	1	109	109
OP002	7	7	1	1	-	-	2	2	88	88
OP003	24	24	20	19	2	2	3	3	350	347
OP004	8	8	6	6	2	2	2	2	150	150

Nanocode	Class A Aviation *Causal*	Class A Unique Aviation *Causal*	Class A Aviation *Contributory*	Class A Unique Aviation *Contributory*	Class A Ground *Causal*	Class A Unique Ground *Causal*	Class A Ground *Contributory*	Class A Unique Ground *Contributory*	*All* Classes, Aviation & Ground	*All* Classes, Unique Aviation & Ground
OP005	-	-	-	-	-	-	-	-	27	27
OP006	4	4	2	2	2	2	4	4	126	126
OR001	1	1	-	-	-	-	-	-	32	32
OR002	3	3	1	1	-	-	-	-	47	47
OR003	-	-	-	-	-	-	-	-	6	6
OR004	25	25	14	12	-	-	2	2	181	179
OR005	-	-	2	2	-	-	-	-	13	11
OR006	-	-	2	2	-	-	-	-	4	4
OR007	-	-	2	2	-	-	1	1	53	53
OR008	1	1	1	1	-	-	-	-	41	41
OR009	-	-	1	1	-	-	1	1	19	19
SF001	-	-	-	-	-	-	5	5	28	28
SF002	2	2	1	1	-	-	3	3	169	169
SI001	9	9	11	9	1	1	7	7	253	250
SI002	1	1	3	3	-	-	2	2	40	40
SI003	5	5	14	14	3	3	5	5	228	228
SI004	1	1	4	4	-	-	2	2	121	121
SI005	-	-	-	-	-	-	-	-	5	5
SI006	2	2	-	-	-	-	1	1	15	15
SP001	-	-	-	-	-	-	-	-	12	12
SP002	-	-	2	2	-	-	-	-	24	24
SP003	-	-	2	2	3	3	2	2	29	29
SP004	2	2	7	7	-	-	4	4	59	59
SP005	4	4	12	12	-	-	6	6	107	107
SP006	1	1	9	9	-	-	3	3	149	149
SP007	1	1	3	3	-	-	-	-	34	34
SV001	1	1	-	-	1	1	2	2	48	48
SV002	1	1	6	6	1	1	-	-	54	54
SV003	-	-	-	-	-	-	-	-	17	17
SV004	-	-	-	-	1	1	4	4	20	20

Appendix B

DoD HFACS 7.0 Checklist



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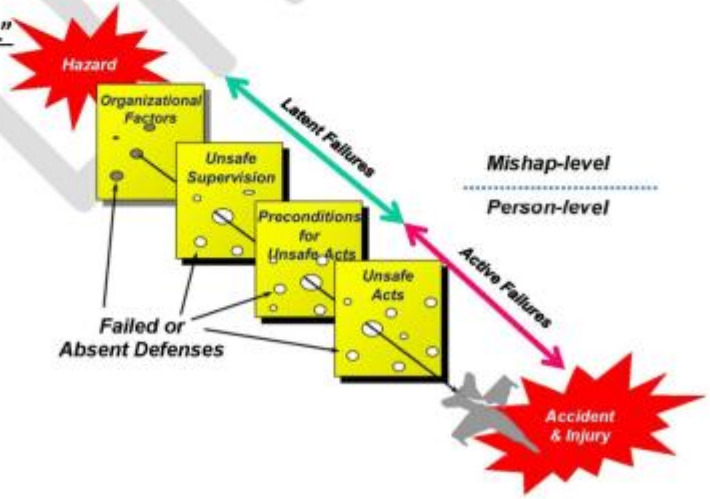
INTRODUCTION

Human error remains the leading cause of Air Force mishaps. Mishaps are rarely attributable to a single cause, but are often the end result of a series of errors. This can be depicted visually through the "Swiss Cheese Model" (see below). Root cause analysis can be performed in many different ways, but it always comes down to first asking why something occurred. Start with the problem, asking what prompted the problem to happen in the first place. Then keep taking it further and further until you can pinpoint specific processes, policies, or procedures that didn't work. It all comes down to asking "why?" until you see a pattern in the problem. This HFACS flip book was developed as a tool to guide in root cause analysis, and can also be used to develop interview questions, determine potential risk-management hazards, and detect human error trends. The concept behind the Human Factors Analysis and Classification (HFACS) flip book is to provide a quick reference guide for mishap investigators. This booklet demonstrates a hierarchical approach to link each act to a precondition and to a supervisory and/or organizational role.

BENEFITS OF DOD HFACS

1. Structured analysis of human error
   - Sophisticated, complete…yet operational
   - Detects error patterns
2. Gets to the "why"… not just the "what"
   - More insightful root cause determination
   - Better investigator analysis
3. A new, data-driven approach
   - Supports research across the Force
   - Easily applied to large body of existing data
   - Easily applied to new mishaps and events
4. Can be used for more than Operational purposes
   - Can be as a risk-management tool for brainstorming
   - Can help develop interview questions
   - Applies to both on-duty and off-duty mishaps

"SWISS-CHEESE MODEL"



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ACTS

Q1.

Did the mishap person(s) make a performance-based error? ❑ Yes, AE100, go to p.4 & Q2
❑ No, go to Q2

Q2.

Was a mishap person(s) actions a result of poor judgment and/or decision? ❑ Yes, AE200, go to p.5 & Q3
❑ No, go to Q3

Q3.

Did a mishap person(s) violate a commonly known law or regulation? ❑ Yes, AV100, go to p.6 & Q4
❑ No, go to Q4

PRECONDITIONS

Q4.

Was the environment a factor in the mishap? ❑ Yes, go to Q4a
❑ No, go to Q5

Q4a.

Did the physical environment affect the mishap person(s)? ❑ Yes, PE100, go to p.7 & Q4b
❑ No, go to Q4b

Q4b.

Did the technological environment affect the mishap person(s)? ❑ Yes, PE200, go to p.8 & Q5
❑ No, go to Q5

Q5.

Did the mishap person(s) mental, sensory, or physical state contribute to the mishap? ❑ Yes, go to Q5a
❑ No, go to Q6

Q5a.

Did the mishap person have a medical or physical condition? ❑ Yes, PC300, go to p.9 & Q5b
❑ No, go to Q5b

Q5b.

Did the mishap person(s) state of mind create an unsafe situation? ❑ Yes, PC200, go to p.10 & Q5d
❑ No, go to Q5d

Q5c.

Was sensory information misperceived or misunderstood? ❑ Yes, PC500, go to p.11 & Q5e
❑ No, go to Q5e

Q5d.

Did the mishap person(s) mental awareness create an unsafe situation? ❑ Yes, PC100, go to p.12 & Q6
❑ No, go to Q6

Q6.

Did challenges with teamwork contribute to the mishap? ❑ Yes, PP100, go to p.13 & Q7
❑ No, go to Q7

SUPERVISION

Q7.

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Did supervision or supervisory policies contribute to the mishap? ..... ❑ Yes, go to Q7a
..... ❑ No, go to Q8

Q7a.

Did a supervisor violate a commonly known law or regulation? ..... ❑ Yes, SV100, go to p.14 & Q7b
..... ❑ No, go to Q7b

Q7b.

Did supervision fail to plan or assess known hazards? ..... ❑ Yes, SP100, go to p.15 & Q7c
..... ❑ No, go to Q7c

Q7c.

Did a supervisor or supervision prove inadequate? ..... ❑ Yes, SI100, go to p.16 & Q8
..... ❑ No, go to Q8

ORGANIZATIONAL INFLUENCES

Q8.

Did the organization or organizational policies contribute to the mishap? ..... ❑ Yes, go to Q8a
..... ❑ No, Finished!

Q8a.

Did a problem with resources create an unsafe situation? ..... ❑ Yes, OR100, go to p.17 & Q8b
..... ❑ No, go to Q8b

Q8b.

Was selection or training of personnel a factor? ..... ❑ Yes, OP100, go to p.18 & Q8c
..... ❑ No, go to Q8b

Q8c.

Did an organizational instruction or policy create an unsafe situation? ..... ❑ Yes, OI100, go to p.19 & Q8d
..... ❑ No, go to Q8d

Q8d.

Did the safety climate/culture contribute to an unsafe situation? ..... ❑ Yes, OC100, go to p.20
..... ❑ No, Finished!

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ACTS

"Active Failures or Actions"

PERFORMANCE-BASED ERRORS (AE100): are factors that occur when a specific action is performed in a manner that leads to a mishap.

Unintended Operation of Equipment	AE101
Checklist Not Followed Correctly	AE102
Procedure Not Followed Correctly	AE103
Over-Controlled/Under-Controlled Aircraft/Vehicle	AE104
Breakdown in Visual Scan	AE105
Rushed or Delayed a Necessary Action	AE107

AE101 Unintended Operation of Equipment: is a factor when an individual's movements inadvertently activate or deactivate equipment, controls or switches when there is no intent to operate the control or device. This action may be noticed or unnoticed by the individual.

AE102 Checklist Not Followed Correctly: is a factor when the individual, either through an act of commission or omission, makes a checklist error or fails to run an appropriate checklist.

AE103 Procedure Not Followed Correctly: is a factor when a procedure is performed incorrectly or accomplished in the wrong sequence.

AE104 Over-Controlled/Under-Controlled Aircraft/Vehicle/System: is a factor when an individual responds inappropriately to conditions by either over- or under-controlling the aircraft/vehicle/system. The error may be a result of preconditions or a temporary failure of coordination.

AE105 Breakdown in Visual Scan: is a factor when the individual fails to effectively execute visual scan patterns.

AE107 Rushed or Delayed a Necessary Action: is a factor when an individual takes the necessary action as dictated by the situation but performs these actions too quickly or too slowly.

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JUDGMENT & DECISION-MAKING ERRORS (AE200): are factors that occur when an individual proceeds as intended, yet the plan proves inadequate or inappropriate for the situation, e.g. "An honest mistake."

Inadequate Real-Time Risk Assessment	AE201
Failure to Prioritize Tasks Adequately	AE202
Ignored a Caution/Warning	AE205
Wrong Choice of Action During an Operation	AE206

AE201 Inadequate Real-Time Risk Assessment: is a factor when an individual fails to adequately evaluate the risks associated with a particular course of action and this faulty evaluation leads to inappropriate decision-making and subsequent unsafe situations.

AE202 Failure to Prioritize Tasks Adequately: is a factor when the individual does not organize, based on accepted prioritization techniques, the tasks needed to manage the immediate situation.

AE205 Ignored a Caution/Warning: is a factor when a caution or warning is perceived and understood by the individual but is ignored by the individual.

AE206 Wrong Choice of Action During an Operation: is a factor when the individual, through faulty logic or erroneous expectations, selects the wrong course of action.

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VIOLATIONS (AV100): are factors when the individual *intentionally* breaks the rules and instructions. *"Violations are deliberate."*

Performs Work-Around Violation	AV001
Commits Widespread/Routine Violation	AV002
Extreme Violation - Lack of Discipline	AV003

AV001 Performs Work-Around Violation: is a factor when the consequences/risk of violating published procedures was recognized, consciously assessed and honestly determined by the individual, crew or team to be the best course of action. Routine "work-arounds" and unofficial procedures that are accepted by the community as necessary for operations are also captured under this code.

AV002 Commits Widespread/Routine Violation: is a factor when a procedure or policy violation is systemic in a unit/setting and not based on a risk assessment for a specific situation. It needlessly commits the individual, team, or crew to an unsafe course-of-action. These violations may have leadership sanction and may not routinely result in disciplinary/administrative action. Habitual violations of a single individual or small group of individuals within a unit can constitute a routine/widespread violation if the violation was not routinely disciplined or was condoned by supervisors.

AV003 Extreme Violation – Lack of Discipline: is a factor when an individual, crew or team intentionally violates procedures or policies without cause or need. These violations are unusual or isolated to specific individuals rather than larger groups. There is no evidence of these violations being condoned by leadership. These violations may also be referred to as "exceptional violations."

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PRECONDITIONS

"Latent Failures or Conditions"

ENVIRONMENT: *The environment surrounding a mishap is the physical or technological factors that affect practices, conditions, and actions of individual(s).*

PHYSICAL ENVIRONMENT (PE100): are factors such as weather, climate, fog, brownout (dust or sand storm) or whiteout (snow storm) that affect the actions of individual.

Environmental Conditions Affecting Vision	PE101
Vibration Affects Vision or Balance	PE103
Heat/Cold Stress Impairs Performance	PE106
External Force or Object Impeded an Individual's Movement	PE108
Lights of Other Vehicle/Vessel/Aircraft Affected Vision	PE109
Noise Interference	PE110

PE101 Environmental Conditions Affecting Vision: is a factor that includes obscured windows; weather, fog, haze, darkness; smoke, etc.; brownout/whiteout (dust, snow, water, ash or other particulates); or when exposure to windblast affects the individual's ability to perform required duties.

PE103 Vibration Affects Vision or Balance: is a factor when the intensity or duration of the vibration is sufficient to cause impairment of vision or adversely affect balance.

PE106 Heat/Cold Stress Impairs Performance: is a factor when the individual is exposed to conditions resulting in compromised performance.

PE108 External Force or Object Impeded an Individual's Movement: is a factor when acceleration forces greater than one second cause injury or prevent/interfere with the performance of normal duties. Do not use this code to capture G-induced loss of consciousness.

PE109 Lights of Other Vehicle/Vessel/Aircraft Affected Vision: is a factor when the absence, pattern, intensity or location of the lighting of other vehicle/vessel/aircraft prevents or interferes with safe task accomplishment.

PE110 Noise Interference: is a factor when any sound not directly related to information needed for task accomplishment interferes with the individual's ability to perform that task.

TECHNOLOGICAL ENVIRONMENT (PE200): are factors when automation or the design of the workspace affects the actions of an individual.

Seat and Restraint System Problems	PE201
Instrumentation and Warning System Issues	PE202
Visibility Restrictions (not weather related)	PE203
Controls and Switches are Inadequate	PE204
Automated System Creates an Unsafe Situation	PE205
Workspace Incompatible with Operation	PE206
Personal Equipment Interference	PE207
Communication Equipment Inadequate	PE208

PE201 Seat and Restraint System Problems: is a factor when the design of the seat or restraint system, the ejection system or seat comfort has poor impact-protection qualities.

PE202 Instrumentation and Warning System Issues: is a factor when instrument factors such as design, reliability, lighting, location, symbology, size, display systems, auditory or tactile situational awareness or warning systems create an unsafe situation.

PE203 Visibility Restrictions (not weather related): is a factor when the lighting system, windshield/windscreen/canopy design, or other obstructions prevent necessary visibility. This includes glare or reflections on the windshield/windscreen/canopy. Visibility restrictions due to weather or environmental conditions are captured under PE101.

PE204 Controls and Switches are Inadequate: is a factor when the location, shape, size, design, reliability, lighting or other aspect of a control or switch are inadequate.

PE205 Automated System Creates an Unsafe Situation: is a factor when the design, function, reliability, symbology, logic or other aspect of automated systems creates an unsafe situation.

PE206 Workspace Incompatible with Operation: is a factor when the workspace is incompatible with the task requirements and safety for an individual.

PE207 Personal Equipment Interference: is a factor when the individual's personal equipment interferes with normal duties or safety.

PE208 Communication Equipment Inadequate: is a factor when communication equipment is inadequate or unavailable to support task demands. This includes electronically or physically blocked transmissions. Communications can be voice, data or multi-sensory.

FOR REFERENCE USE ONLY

PHYSICAL AND MENTAL STATE: *The mental and physical states of individuals are how people know, think, learn, understand, perceive, feel, hurt, guess, recognize, notice, want, wish, hope, decide, expect, remember, forget, imagine, and believe.*

PHYSICAL PROBLEM (PC300): are medical or physiological conditions that can result in unsafe situations.

Substance Effects (alcohol, supplements, medications, drugs)	PC302
Loss of Consciousness (sudden or prolonged onset)	PC304
Physical Illness/Injury	PC305
Fatigue	PC307
Trapped Gas Disorders	PC310
Evolved Gas Disorders	PC311
Hypoxia/Hyperventilation	PC312
Inadequate Adaptation to Darkness	PC314
Dehydration	PC315
Body Size/Movement Limitations	PC317
Physical Strength & Coordination (inappropriate for task demands)	PC318
Nutrition/Diet	PC319

PC302 Substance Effects (alcohol, supplements, medications, drugs): is a factor when the individual uses legal or illegal drugs, supplements, energy drinks or any other substance with measurable effect that interferes with performance.

PC304 Loss of Consciousness (sudden or prolonged onset): is a factor when the individual has a loss of functional capacity/consciousness due to G-LOC, seizure, trauma or any other cause.

PC305 Physical Illness/Injury: is a factor when a physical illness, injury, deficit or diminished physical capability causes an unsafe situation. This includes pre-existing and operationally-related medical conditions, over-exertion, motion sickness, etc.

PC307 Fatigue: is a factor causing diminished physical/mental capability resulting from chronic or acute periods of prolonged wakefulness, sleep deprivation, jet lag, shift work or poor sleep habits.

PC310 Trapped Gas Disorders: is a factor when gasses in the middle ear, sinuses, teeth or intestinal tract expand or contracts.

PC311 Evolved Gas Disorders: is a factor when inert-gas evolves in the blood causing an unsafe situation. This includes chokes, CNS, bends, paresthesias or other conditions caused by inert-gas evolution.

PC312 Hypoxia/Hyperventilation: is a factor when the individual has insufficient oxygen supply to the body and/or breathing above physiological demands causes impaired function.

PC314 Inadequate Adaptation to Darkness: is a factor when the normal human limitation of dark-adaptation rate affects safety, for example, when transitioning between aided and unaided night vision.

PC315 Dehydration: is a factor when the performance of the individual is degraded due to dehydration as a result of excessive fluid losses due to heat stress or due to insufficient fluid intake.

PC317 Body Size/Movement Limitations: is a factor when the size, strength, dexterity, mobility or other biomechanical limitations of an individual creates an unsafe situation. It must be expected that the average individual qualified for that duty position could accomplish the task in question.

PC318 Physical Strength & Coordination (inappropriate for task demands): is a factor when the relative physical strength and/or coordination of the individual is not adequate to support task demands.

PC319 Nutrition/Diet: is a factor when the individual's nutritional state or poor dietary practices are inadequate to fuel the brain and body functions resulting in degraded performance.

FOR REFERENCE USE ONLY

STATE OF MIND (PC200): are factors when an individual's personality traits, psychosocial problems, psychological disorders or inappropriate motivation creates an unsafe situation.

Psychological Problem	PC202
Life Stressors	PC203
Emotional State	PC204
Personality Style	PC205
Overconfidence	PC206
Pressing	PC207
Complacency	PC208
Motivation	PC209
Mentally Exhausted (Burnout)	PC215

PC202 Psychological Problem: is a factor when the individual met medical criteria for a psychiatric disorder.

PC203 Life Stressors: is a factor when the individual's performance is affected by life circumstance problems (includes relationship issues, financial stressors, recent move, etc.).

PC204 Emotional State: is a factor when the individual is under the influence of a strong positive or negative emotion and that emotion interferes with duties.

PC205 Personality Style: is a factor when the individual's personal interaction with others creates an unsafe situation. Examples are authoritarian, over-conservative, impulsive, invulnerable, submissive or other personality traits that result in degraded performance.

PC206 Overconfidence: is a factor when the individual overvalues or overestimates personal capability, the capability of others or the capability of aircraft/vehicles or equipment.

PC207 Pressing: is a factor when the individual knowingly commits to a course of action that excessively presses the individual and/or their equipment beyond reasonable limits (e.g., pushing self or equipment too hard).

PC208 Complacency: is a factor when the individual has a false sense of security, is unaware of, or ignores hazards and is inattentive to risks.

PC209 Motivation: is a factor when the individual's motivation to accomplish a task/mission is excessive, weak, indecisive or when personal goals supersede the organization's goals.

PC215 Mentally Exhausted (Burnout): is a factor when the individual has the type of exhaustion associated with the wearing effects of high operational and/or lifestyle tempo in which operational requirements impinge on the ability to satisfy personal requirements and leads to degraded effectiveness.

FOR REFERENCE USE ONLY

SENSORY MISPERCEPTION (PC500): are factors resulting in degraded sensory inputs (visual, auditory or vestibular) that create a misperception of an object, threat or situation.

Motion Illusion – Kinesthetic	PC501
Turning/Balance Illusion – Vestibular	PC502
Visual Illusion	PC503
Misperception of Changing Environment	PC504
Misinterpreted/Misread Instrument	PC505
Misinterpretation of Auditory/Sound Cues	PC507
Spatial Disorientation	PC508
Temporal/Time Distortion	PC511

PC501 Motion Illusion – Kinesthetic: is a factor when physical sensations of the ligaments, muscles or joints cause the individual to have an erroneous perception of orientation, motion or acceleration. (If this illusion leads to spatial disorientation you must code PC508.)

PC502 Turning/Balance Illusion – Vestibular: is a factor when stimuli acting on the balance organs in the middle ear cause the individual to have an erroneous perception of orientation, motion or acceleration. (If this illusion leads to spatial disorientation you must code PC508.)

PC503 Visual Illusion: is a factor when visual stimuli result in an erroneous perception of orientation, motion or acceleration. (If this illusion leads to spatial disorientation you must code PC508.)

PC504 Misperception of Changing Environment: is a factor when an individual misperceives or misjudges altitude, separation, speed, closure rate, road/sea conditions, aircraft/vehicle location within the performance envelope or other operational conditions.

PC505 Misinterpreted/Misread Instrument: is a factor when the individual is presented with a correct instrument reading but its significance is not recognized, it is misread or is misinterpreted.

PC507 Misinterpretation of Auditory/Sound Cues: is a factor when the auditory inputs are correctly interpreted but are misleading/disorienting or when the inputs are incorrectly interpreted and cause an impairment of normal performance.

PC508 Spatial Disorientation: is a factor when an individual fails to correctly sense a position, motion, or attitude of the aircraft/vehicle/vessel or of oneself. Spatial Disorientation may be unrecognized and/or result in partial or total incapacitation.

PC511 Temporal/Time Distortion: is a factor when the individual experiences a compression or expansion of time relative to reality. This is often associated with a "fight or flight" response.

FOR REFERENCE USE ONLY

MENTAL AWARENESS (PC100): are factors of an attention management or awareness failure that affects the perception or performance of individuals.

Not Paying Attention	PC101
Fixation	PC102
Task Over-Saturation/Under-Saturation	PC103
Confusion	PC104
Negative Habit Transfer	PC105
Distraction	PC106
Geographically Lost	PC107
Interference/Interruption	PC108
Technical or Procedural Knowledge Not Retained after Training	PC109
Inaccurate Expectation	PC110

PC101 Not Paying Attention: is a factor when there is a lack of state of alertness or a readiness to process immediately available information. The individual has a state of reduced conscious attention due to a sense of security, self-confidence, boredom or a perceived absence of threat from the environment. This may often be a result of highly repetitive tasks.

PC102 Fixation: is a factor when the individual is focusing all conscious attention on a limited number of environmental cues to the exclusion of others.

PC103 Task Over-Saturation/Under-Saturation: is a factor when the quantity of information an individual must process exceeds their mental resources in the amount of time available to process the information.

PC104 Confusion: is a factor when the individual is unable to maintain a cohesive and orderly awareness of events and required actions and experiences a state characterized by bewilderment, lack of clear thinking or (sometimes) perceptual disorientation.

PC105 Negative Habit Transfer: is a factor when the individual reverts to a highly learned behavior used in a previous system or situation and that response is inappropriate for current task demands.

PC106 Distraction: is a factor when the individual has an interruption of attention and/or inappropriate redirection of attention by an environmental cue or mental process.

PC107 Geographically Lost: is a factor when the individual is at a different location from where one believes they are.

PC108 Interference/Interruption: is a factor when an individual is performing a highly automated/learned task and is distracted by another cue/event that results in the interruption and subsequent failure to complete the original task or results in skipping steps in the original task.

PC109 Technical or Procedural Knowledge Not Retained after Training: is a factor when the individual fails to absorb/retain required information or is unable to recall past experience needed for safe task completion.

PC110 Inaccurate Expectation: is a factor when the individual expects to perceive a certain reality and those expectations are strong enough to create a false perception of the expectation.

TEAMWORK (PP100): factors refer to interactions among individuals, crews, and teams involved with the preparation and execution of a task/mission that resulted in human error or an unsafe situation.

Failure of Crew/Team Leadership	PP101
Inadequate Task Delegation	PP103
Rank/Position Intimidation	PP104
Lack of Assertiveness	PP105
Critical Information Not Communicated	PP106
Standard/Proper Terminology Not Used	PP107
Failed to Effectively Communicate	PP108
Task/Mission Planning/Briefing Inadequate	PP109

PP101 Failure of Crew/Team Leadership: is a factor when the crew/team leadership techniques failed to facilitate a proper crew/team climate, to include establishing and maintaining an accurate and shared understanding of the evolving task and plan on the part of all crew/team members.

PP103 Inadequate Task Delegation: is a factor when the crew/team members failed to actively manage the distribution of tasks to prevent the overloading of any individual member.

PP104 Rank/Position Intimidation: is a factor when the differences in rank of the team/crew caused the task performance capabilities to be degraded. Also, conditions where formal or informal authority gradient is too steep or too flat across a crew/team and this condition degrades collective or individual performance.

PP105 Lack of Assertiveness: is a factor when an individual failed to state critical information or solutions with appropriate persistence and/or confidence.

PP106 Critical Information Not Communicated: is a factor when known critical information was not provided to appropriate individuals in an accurate or timely manner.

PP107 Standard/Proper Terminology Not Used: is a factor when clear and concise terms, phrases, hand signals, etc. per service standards and training were not used.

PP108 Failed to Effectively Communicate: is a factor when communication is not understood or is misinterpreted as the result of behavior of either sender or receiver. Communication failed to include backing up, supportive feedback or acknowledgement to ensure that personnel correctly understood announcements or directives.

PP109 Task/Mission Planning/Briefing Inadequate: is a factor when an individual, crew or team failed to complete all preparatory tasks associated with planning/briefing the task/mission.

FOR REFERENCE USE ONLY

SUPERVISION

"Direct Supervisory Chain of Command"

SUPERVISION: *Supervision is a factor in a mishap if the methods, decisions or policies of the supervisory chain of command directly affect practices, conditions or actions of the individual(s).*

SUPERVISORY VIOLATIONS (SV100): are factors when supervisors willfully disregard instructions or policies.

Failure to Enforce Existing Rules (supervisory act of omission)	SV001
Allowing Unwritten Policies to Become Standard	SV002
Directed Individual to Violate Existing Regulations	SV003
Authorized Unqualified Individuals for Task	SV004

SV001 Failure to Enforce Existing Rules (supervisory act of omission): is a factor when unit (organizational) and operating rules have not been enforced by a supervisor.

SV002 Allowing Unwritten Policies to Become Standard: is a factor when unwritten or "unofficial" policy is perceived and followed by the individual, although it has not been formally recognized by the organization.

SV003 Directed Individual to Violate Existing Regulations: is a factor when a supervisor directs a subordinate to violate existing regulations, instructions or technical guidance.

SV004 Authorized Unqualified Individuals for Task: is a factor when an individual has not met the general training requirements for the job/weapon system and is considered non-current but supervision/leadership inappropriately allows the individual to perform the task for which the individual is non-current.

PLANNED INAPPROPRIATE OPERATIONS (SP100): are factors when supervision fails to adequately plan or assess the hazards associated with an operation and allows for unnecessary risk.

Directed Task Beyond Personnel Capabilities	SP001
Inappropriate Team Composition	SP002
Selected Individual with Lack of Current or Limited Experience	SP003
Performed Inadequate Risk Assessment – Formal	SP006
Authorized Unnecessary Hazard	SP007

SP001 Directed Task Beyond Personnel Capabilities: is a factor when supervisor/management directs personnel to undertake a task beyond their skill level or beyond the capabilities of their equipment.

SP002 Inappropriate Team Composition: is a factor when the makeup of the crew/team should have reasonably raised safety concerns in the minds of members involved in the task, or in any other individual directly related to the scheduling of this task.

SP003 Selected Individual with Lack of Current or Limited Experience: is a factor when the supervisor selects an individual whose experience is not sufficiently current or proficient to permit safe task execution.

SP006 Performed Inadequate Risk Assessment – Formal: is a factor when supervision does not adequately evaluate the risks associated with a task or when pre-mission risk assessment tools/programs are inadequate.

SP007 Authorized Unnecessary Hazard: is a factor when supervision authorizes an activity or task that is unnecessarily hazardous without sufficient cause or need.

FOR REFERENCE USE ONLY

INADEQUATE SUPERVISION (SI100): are factors when department-level or command-level supervision proves inappropriate or improper and/or fails to identify hazards; recognize and control risk; provide guidance, training and/or oversight.

Supervisory/Command Oversight Inadequate	SI001
Improper Role-Modeling	SI002
Failed to Provide Proper Training	SI003
Failed to Provide Appropriate Policy/Guidance	SI004
Personality Conflict with Supervisor	SI005
Lack of Supervisory Responses to Critical Information	SI006
Failed to Identify/Correct Risky or Unsafe Practices	SI007
Selected Individual with Lack of Proficiency	SI008

SI001 Supervisory/Command Oversight Inadequate: is a factor when the availability, competency, quality or timeliness of leadership, supervision or oversight does not meet task demands. Inappropriate supervisory pressures are also captured under this code.

SI002 Improper Role-Modeling: is a factor when the individual's learning is influenced by the behavior of supervisors and when that learning manifests itself in actions that are either inappropriate to the individual's skill level or violate standard procedures.

SI003 Failed to Provide Proper Training: is a factor when one-time or recurrent training programs, upgrade programs, transition programs or any other local training is inadequate or unavailable, etc. (Note: the failure of an individual to absorb the training material in an adequate training program does not indicate a training program problem.)

SI004 Failed to Provide Appropriate Policy/Guidance: is a factor when policy/guidance or lack of a policy/guidance leads to an unsafe situation.

SI005 Personality Conflict with Supervisor: is a factor when a supervisor and individual member experience a "personality conflict" that leads to a dangerous error in judgment/action.

SI006 Lack of Supervisory Responses to Critical Information: is a factor when information critical to a potential safety issue was provided but supervisory/management personnel failed to act upon it (failure to close the loop).

SI007 Failed to Identify/Correct Risky or Unsafe Practices: is a factor when a supervisor fails to identify or correct risky behaviors or unsafe tendencies and/or fails to institute remedial actions. This includes hazardous practices, conditions or guidance.

SI008 Selected Individual with Lack of Proficiency: is a factor when a supervisor selects an individual that is not proficient in a task, mission or event.

FOR REFERENCE USE ONLY

ORGANIZATIONAL INFLUENCES

"Upper-Level Management, Command Level"

ORGANIZATION: *An organization is the communications, actions, omissions or policies of upper-level management that directly or indirectly affect supervisory practices, conditions or actions of the operator(s).*

RESOURCE PROBLEMS (OR100): are factors when processes or policies influence system safety, resulting in inadequate error management or creating an unsafe situation.

Command and Control Resources are Deficient	OR001
Inadequate Infrastructure	OR003
Failure to Remove Inadequate/Worn-Out Equipment in a Timely Manner	OR005
Failure to Provide Adequate Operational Information Resources	OR008
Failure to Provide Adequate Funding	OR009

OR001 Command and Control Resources are Deficient: is a factor when installation resources are inadequate for safe operations. Examples include: command and control, airfield services, battlegroup management, etc.

OR003 Inadequate Infrastructure: is a factor when support facilities (dining, exercise, quarters, medical care, etc.) or opportunity for recreation or rest are not available or adequate. This includes situations where leave is not taken for reasons other than the individual's choice.

OR005 Failure to Remove Inadequate/Worn-Out Equipment in a Timely Manner: is a factor when the process through which equipment is removed from service is inadequate.

OR008 Failure to Provide Adequate Operational Information Resources: is a factor when weather, intelligence, operational planning material or other information necessary for safe operations planning are not available.

OR009 Failure to Provide Adequate Funding: is a factor when an organization or operation does not receive the financial resources to complete its assigned task/mission.

PERSONNEL SELECTION & TRAINING (OS000): are factors if personnel management processes or policies, directly or indirectly, influence system safety and results in poor error management or creates an unsafe situation.

Personnel Recruiting and Selection Policies are Inadequate	OS001
Failure to Provide Adequate Manning/Staffing Resources	OS002

OS001 Personnel Recruiting and Selection Policies are Inadequate: is a factor when the process through which individuals are screened, brought into the service or placed into specialties is inadequate.

OS002 Failure to Provide Adequate Manning/Staffing Resources: is a factor when the process through which manning, staffing or personnel placement or manning resource allocations are inadequate for task/mission demands.

POLICY AND PROCESS ISSUES (OP000): are factors if these processes negatively influence performance and result in an unsafe situation.

Pace of Ops-tempo/Workload	OP001
Organizational Program/Policy Risks not Adequately Assessed	OP002
Provided Inadequate Procedural Guidance or Publications	OP003
Organizational (formal) Training is Inadequate or Unavailable	OP004
Flawed Doctrine/Philosophy	OP005
Inadequate Program Management	OP006
Purchasing or Providing Poorly Designed or Unsuitable Equipment	OP007

OP001 Pace of Ops-tempo/Workload: is a factor when the pace of deployments, workload, additional duties, off-duty education, PME or other workload-inducing conditions of an individual or unit creates an unsafe situation.

OP002 Organizational Program/Policy Risks not Adequately Assessed: is a factor when the potential risks of a large program, operation, acquisition or process are not adequately assessed.

OP003 Provided Inadequate Procedural Guidance or Publications: is a factor when written direction, checklists, graphic depictions, tables, charts or other published guidance is inadequate, misleading or inappropriate.

OP004 Organizational (formal) Training is Inadequate or Unavailable: is a factor when one-time or initial training programs, upgrade programs, transition programs or other training that is conducted outside the local unit is inadequate or unavailable.

OP005 Flawed Doctrine/Philosophy: is a factor when the doctrine, philosophy or concept of operations in an organization is flawed or accepts unnecessary risk which leads to an unsafe situation or unmitigated hazard.

OP006 Inadequate Program Management: is a factor when programs are implemented without sufficient support, oversight or planning.

OP007 Purchasing or Providing Poorly Designed or Unsuitable Equipment: is a factor when the processes through which aircraft, vehicle, equipment or logistical support are acquired allows inadequacies or when design deficiencies allow inadequacies in the acquisition.

CLIMATE/CULTURE INFLUENCES (OC000): are factors where the working atmosphere within the organization influences individual actions resulting in human error. (e.g. command structure, policies and working environment).

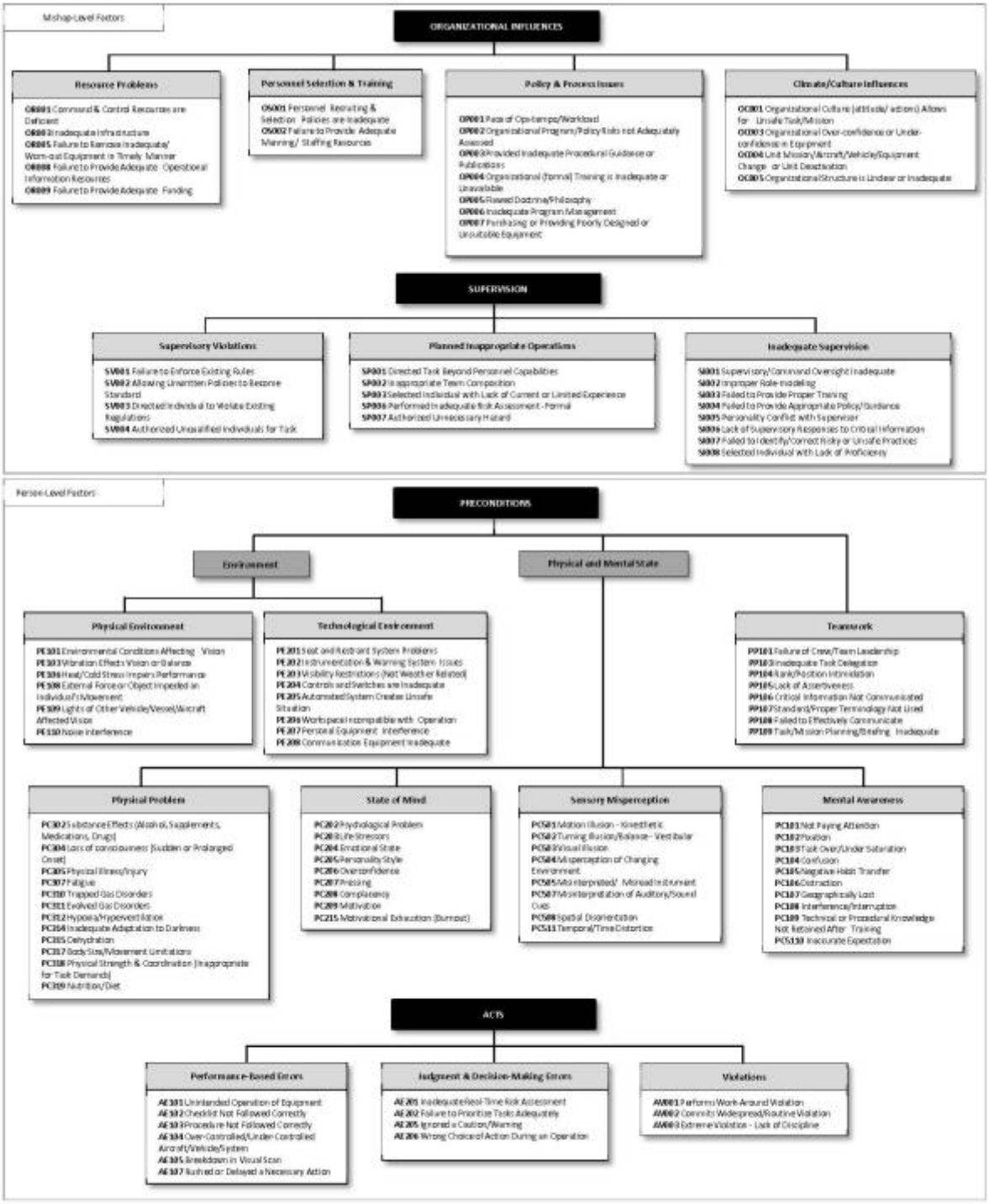
Organizational Culture (attitude/actions) Allows for Unsafe Task/Mission	OC001
Organizational Over-confidence or Under-confidence in Equipment	OC003
Unit Mission/Aircraft/Vehicle/Equipment Change or Unit Deactivation	OC004
Organizational Structure is Unclear or Inadequate	OC005

OC001 Organizational Culture (attitude/actions) Allows for Unsafe Task/Mission: a factor when explicit/implicit actions, statements or attitudes of unit leadership set unit/organizational values (culture) that allow an environment where unsafe task/mission demands or pressures exist.

OC003 Organizational Over-confidence or Under-confidence in Equipment: is a factor when there is organizational over- or under-confidence in an aircraft, vehicle, device, system or any other equipment.

OC004 Unit Mission/Aircraft/Vehicle/Equipment Change or Unit Deactivation: is a factor when the process of changing missions, aircraft/vehicle/equipment or an impending unit deactivation creates an unsafe situation.

OC005 Organizational Structure is Unclear or Inadequate: is a factor when the chain of command of an individual or structure of an organization is confusing, non-standard or inadequate and this creates an unsafe situation.



21

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APPENDIX C

Comments Offered by Student Raters with Rejoinders at Conclusion of Mishap Exercises

Mishap 1 Exercise

Comments Made by Student Raters after Coding a Mishap Using Both Coding Schemes	Rejoinder (after Reading Written Comments)	Overall Impression
Much easier to follow the process. Like definition at bottom of page.	We made definitions more accessible to increase the probability that they would be read and considered.	Positive
I think the definitions are too subjective to get inter-rater reliability. In order to prevent SIBs from coding things badly you need to take it out of their hands. You won't get a reliable system with subjective definitions unless you limit the number of people coding the HF data.	It is a trade-off. While a cadre of consistent coders would increase the inter-rater reliability, the validity would not necessarily increase, as we are hopeful that the questions will help to guide the investigation.	Neutral
I liked this product because it is less subjective and much more logical to go through, rather than just picking definition that fit.		Positive
Good, helps…however someone unfamiliar with all the codes & how they are categorized under the major groupings has to read the individual definitions to make a judgment about the question asked…So in fact you are adding confusion/workload rather than decreasing it.	A fair point. On the other hand, if we are forcing pilots to consider a broader range of HFACS nanocodes, then so much the better. An example of putting the compulsivity of pilots to good use.	Slightly Positive to Slightly Negative
Q5 as an example, I would break up the various conditions rather than ask "could it be all or any of these." Would be extremely more efficient for those with more experience in microcodes. I had to review all the codes to make sure I didn't miss anything (i.e., Q5).	A fair point. We've yet to achieve the right balance of questions and subquestions. Reviewing the codes, which have been vastly reduced, while perhaps inefficient, is not the worst possible outcome (see above reply).	Neutral
My only complaint is that you have to go read the codes ahead of time to answer the questions.		Neutral
As an investigating officer, I did not feel confident to immediately answer "no" per the factors/headers presented, as they can be subjective. So we ended up answering "yes" and went to the appropriate pages "just to verify" that we were not overlooking a factor that was involved.		Neutral
Q5 if select no, then many questions are skipped. Mental, physical, or sensory is vague.	Looks like the students are really concerned about question 5. We will look into that.	Negative

Comments Made by Student Raters after Coding a Mishap Using Both Coding Schemes	Rejoinder (after Reading Written Comments)	Overall Impression
The top tier questions are vague to the point of an expected reduction in HFAC entries because of unawareness of included lower tier items.		Negative
Good basic idea. Maybe make questions provide more clues to HFACS definition in its category.	The issue with this suggestion is the risk of making questions too narrow. For example, if one concept is illustrated in the definition, the other concepts not illustrated are at risk for being overlooked.	Positive
This was much easier + clearer process w/the guide book to work with. This is a better product – Impliment (sic).		Positive
Recommendations- Layman – Some of the questions are very similar to a non-medical person. Q8b – Codes forget selection – not as much on training.	Not sure what this means. See next comment and reply.	Neutral
Q8b relates mostly or solely to selection and not training. Q2 Differentiate between judgment and decision. Define each.	There are only two nanocodes under this subquestion: - OR006 Personnel Recruiting and Selection Policies are Inadequate - OR007 Failure to Provide Adequate Manning/Staffing Resources The students have a point and we will address this issue. Absolutely. Those words are underlined because they will be hyperlinked with their definitions when the product becomes electronic. In any case, currently the nanocodes and their definitions provide differentiation.	Neutral
- Easier to use. - Need to place the definitions of the under-lined words in the questions under the questions. Q4 & Q5 (Overhead Questions) Can/could be dropped and just make the Q4a, Q4b, Q5a, Q5b, etc. overhead questions or do the above suggestion w/the definitions.	See comment about hypertext and underlined words above.	Positive
Yes, go to AE100 p. 4 and then Q2. - Suggest to read yes, go to (AE Series) nanocodes and then Q2.		Neutral

Mishap 2 Exercise

Comments Made by Student Raters after Coding a Mishap Using Both Coding Schemes	Rejoinder (after Reading Written Comments)	Overall Impression
- Recommend rephrasing Q5 to also focus attention on the MPs state of mind going into the mishap sortie - We perceived the question as an inquiry into (among other things) any mental problems as opposed to state of mind (which isn't addressed until a subquestion). Consider putting examples next to the question.	Yes, we clearly need to reconsider the subquestions. We have considered using examples. Our hesitancy to do so is that the examples cannot be inclusive enough and thus are likely to prematurely steer investigators away from a full consideration of the question.	Neutral
Much better system, still very subjective in that different groups will have different answers.	That is the point of the inter-rater reliability study, to determine the extent of the subjectivity problem.	Positive
Defining the key words underlined would help people better understand the question. i.e., Q4b: actually define "technological environment."	Agreed, underlined words will be hyper-linked to their definitions.	Neutral
Better for research processes & reference points. Def of each term helpful		Positive
DoD HFACS 7.0 checklist is awesome!!		Positive
pg 2 – Q5b – "Yes, PC200, go to p.10 & Q5d" – should reference Q5c. pg 2 – Q5c – "Yes, PC500, go to p.11 & Q5c" – should reference Q5d. -Much more efficient, simpler. -Crew chief proof.		Positive
Easier to organize with this method. However, the question headings do not give one a good representation of the subcategories. We found ourselves reading the subcategories to see if the main question applied.	We are finding this strategy commonly employed.	Positive
The booklet is a fantastic tool. -A lot easier and a lot less intimidating.		Positive
This mishap seems too simple to "nail"; there can be so many different interpretations on how to solve the problem.		Neutral
Our team felt like using the second method (*7.0*) allowed us to work small to big and gave the assessment some structure. Method was laid out better and allowed quicker references and definitions.		Positive
Some of the HFACS are redundant, which can cause confusion on the best choice. Good to have definition present.	Yes, we are working on reducing, if not eliminating, redundancy.	Positive

Comments Made by Student Raters after Coding a Mishap Using Both Coding Schemes	Rejoinder (after Reading Written Comments)	Overall Impression
Some of the codes are still redundant (PC 106 & 108). Some of the main questions don't highlight every aspect of the subquestions: i.e., Q4 only made me think of physical environment. If I marked no and skipped to Q5, I would not have considered technological environment. In order to cover all possibilities, you have to disregard the main questions and look at all possibilities in that category. That makes the main questions not only irrelevant, but also wasted effort/time.	Agreed. We will continue to refine the codes. Yes, the subquestions need work. As noted above, we are finding this strategy commonly employed.	Neutral
The format surely makes the choices for the codes easier, but the selection process is subjective in nature.		Positive
Every subHFAC could be Y or NO questions also and the codes could be generated easily from the answers with a simple software, Along with the software program, the database could offer a 100-question survey.	Seems as though that would be a labor-intensive process, even with fewer codes to consider. Not sure many investigators would comply.	Neutral

LIST OF ABBREVIATIONS AND ACRONYMS

AFI	Air Force instruction
AMIC	Aircraft Mishap Investigation Course
AFSAS	Air Force Safety Automated System
ASAP	Aviation Safety Action Program
DoD	Department of Defense
FY	fiscal year
HFACS	Human Factors Analysis and Classification System
MOFE	Memorandum of Final Evaluation
SIB	Safety Investigation Board
USAF	U.S. Air Force

GLOSSARY

Causes – Deficiencies that, if corrected, would likely have prevented or mitigated damage and/or injury. Cause does not imply blame. Events/conditions that are highly probable results of other events/conditions are not causes. They should be rated as either contributors or outcomes.

Class A Mishap – The resulting total cost of damages to Government and other property is $2 million or more, a DoD aircraft is destroyed (excluding UAS [unmanned aircraft systems] Groups 1, 2, or 3), or an injury or occupational illness results in a fatality or permanent total disability.

Class B Mishap – The resulting total cost of damages to Government and other property is $500,000 or more, but less than $2 million. An injury or occupational illness results in permanent partial disability, or when three or more personnel are hospitalized for inpatient care (which, for mishap reporting purposes only, does not include just observation or diagnostic care) as a result of a single mishap.

Class C Mishap – The resulting total cost of property damages to Government and other property is $50,000 or more, but less than $500,000, or a nonfatal injury or illness results in 1 or more days away from work, not including the day of the injury.

Class D Mishap – The resulting total cost of property damage is $20,000 or more, but less than $50,000, or a recordable injury or illness not otherwise classified as a Class A, B, or C mishap. A Class D mishap is any nonfatal injury or occupational illness that does not meet the definition of lost time. These are cases where, because of injury or occupational illness, the employee only works partial days, has restricted duties or was transferred to another job, and required medical treatment greater than first aid. Loss of consciousness (not including G-induced loss of consciousness, which is considered Class E) is considered a Class D mishap when it is a direct result of a nonfatal injury or occupational illness.

Class E Event – An unplanned occurrence, or series of occurrences, that does not meet the reporting criteria of a mishap.

Contributors – Single events/conditions that are essential to the mishap sequence. They offer an independent contribution or allow the progression of other events/conditions. If an event/condition is both contributory and causal, rate it only as causal.

Factor – Any deviation, out-of-the-ordinary, or deficient action or condition discovered in the course of a mishap investigation that in the board's opinion contributed to the eventual outcome. Determining mishap factors (and eliminating non-factors) enables the investigators to focus the investigation from all the issues under examination to those specific areas that are significant in the mishap sequence. Factors explain why causes, such as pilot error, supervision, or equipment failure, occurred. Factors are not mutually exclusive but are often interrelated and in some cases influence each other.

Non-Factors Worthy of Discussion (NFWODs) – NFWODs typically fall into one of three categories: areas uncovered during the investigation that did not cause the mishap or influence the outcome but should be fixed due to the potential to be a factor in a future mishap (e.g., incorrect information in a maintenance TO [technical order]), areas that were thoroughly investigated and subsequently ruled out as factors (to provide context to the audience on why these areas are not factors), and areas that may be considered an interest item to the convening authority (e.g., risk management, crew resource management, etc.). NFWODs are the source for Other Findings and Recommendations of Significance.